RAY-RAN POLYTEST

Product User Manual

Advanced Auto Density Gradient Column

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POLYMER TEST EQUIPMENT FOR WORLD WIDE QUALITY CONTROL

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User Manual

Thank you for purchasing the Ray-Ran Auto Density Gradient Apparatus. Please read this manual before operation. If you have any questions regarding the installation and operation of the equipment, please contact Ray-Ran for assistance.

Description of The Machine

The Gradient Column Method accurately determines the density of small solid specimens in any form eg. sheet, film, granule, powder etc.

The glass test tube is filled with two miscible solutions. The resulting mixture varies at a linear rate with the lowest density at the top of the tube and the highest density at the bottom.

Calibrated glass marker floats of precisely known densities are introduced into the column and sink to a point where the density matches that of the solution.

The apparatus uses a linear encoder to calibrate the gradient of the column. This is achieved by focusing the optical microscope onto the centre of the calibrated float and entering the floats density value into the microprocessor.

A sample of unknown density is introduced to the column and allowed to reach equilibrium. The linear encoder measures the samples position in the tube relative to the marker floats which is then displayed on the LCD as its density.

Depending on the columns use or age the density distribution of the gradient can remain stable for up to 40 weeks.

For additional information refer to the test standard ISO 1183

Lifting & Installation

It is recommended The Density Column be lifted by two people and placed on a level, robust bench at a height that is suitable for the operator to take accurate measurements. The apparatus should be shielded from direct sunlight to prevent algae growth within the column. If the room temperature is above 23° C the column should be within reach of a mains water supply and waste or connected to a pumped cooling device.

Electrical Characteristics	
240 50hz	5amp
110 60hz	

Please ensure that the mains cable plug is fitted into an electrical safety device before turning on the apparatus. **This Appliance Must Be Earthed**

Caution! Please do not turn on apparatus until the water jacket has been filled with fluid as this may damage the water pump.

The water jacket may be filled from the top of the column through one of the test tube holes. The use of de-ionised water in addition to 100ml of ethylene glycol type antifreeze will keep the jacket clean and algae free. The liquid should be Luke warm to reduce the risk of thermal shock and stress to the water jackets material.
Caution! Please pay great attention to the water mark levels shown on the front of the main cabinet. These levels are marked to show the water fill level of the jacket relative to the number of test tubes to be used. Please do not fill above these levels as excess water may spill into the rear of the cabinet.

The test tube in which a gradient is to be built, can be left in situ provided the tube clamp is holding the tube in place.

Caution! Any graduated tubes left empty and not clamped will rise when the water jacket is filled and may cause a hazard.

Power Up

When the machine is first turned on after filling the water jacket the display will read

- **<Move sight to home position>**

Move the microscope crosshead in an upward direction to the top rail until a beep can be heard. When the beep sounds this means that the sight is in its home position. Please note that this only has to be done when the power is first turned on.

The display will now read

- **<Main Menu> <Calibration>**

See column calibration.

Thermal Printer

If a Thermal Printer has been supplied with the Density Column simply connect the supplied RS232 data transfer cable from the printer to the RS232 socket located at the rear of the columns control box.

If the Thermal Printer has been supplied after initial installation of the apparatus you will need to configure the apparatus for printing mode. To do this,

- When **<Main Menu> <Calibration>** is displayed on the LCD press and hold the green button for 10 seconds. **<Printer On>** will display briefly on the LCD. Repeat the procedure to turn the printer off.

Setting the Temperature

To set the required temperature of the jacket press the up/down keys on the temperature controller. Please allow 30 minutes for the temperature of the fluid inside the jacket to reach equilibrium.

Cooling Coil

If the ambient temperature exceeds 20° C it is advisable to cool the water bath by connecting either a tap water supply or preferably a chiller system (an option which can be supplied by Ray-Ran) to the cooling coil. This will allow the temperature controller to work more effectively ensuring temperature accuracy within the column.

Reduce the ambient temperature of the bath to below 20^{o}C using the chiller system and leave to stabilise. Set the temperature controller to 23^{o}C set point, which will then go into control mode and keep the water bath at 23^{o}C

Low cost Chiller Units can be purchased from Ray-Ran, please contact for details & quotations.

Filling Equipment

The Pumped Filling Equipment is used to build a density gradient column over a required range by connecting 2 conical flasks which are secured to the apparatus by a Polycarbonate plate. A screwed pinchcock is fitted for controlling the flow of liquid through silicone rubber tubes.

The filing system and the flask stirrer are turned on/off using the switches located on the front of the electronics cabinet.

If the standard pumped filling system is to be used please follow the instructions in this manual. If the microprocessor filling equipment is to be used instead of the pumped filling equipment please consult its own technical manual.

Filling a Gradient Column

Mixing Liquids

To build a density gradient column two solutions of suitable miscible liquids are needed. 860cc of each liquid will be required. **Solution A should be a low density** and **solution B should be high density**.

To calculate the densities needed to build a successful column first take into account the density range to be covered.

- Reduce the range from the lowest density required from solution A by **20%**
- Increase the range to the highest density of solution B by **30%**

Example:

- Range required 0.90 – 1.00
- Solution A = 0.90 - 20% = 0.88
- Solution B = 1.00 + 30% = 1.03

The density of the solutions can be estimated with hydrometers, standard dilution tables or with density floats. (the lowest float should sink steadily in solution A and the highest float should rise steadily in solution B)

A Table of suitable liquid systems and an Ethanol/Water standard dilution table are include with this manual.

If a water based system is to be used it is advisable to de-aerate the solutions after mixing by vacuum or gentle heating. If the heating method is used it is important to note the suppliers recommendations and comments on fumes given off by the solutions. Each solution must be mixed thoroughly.

PLEASE CONSULT THE MANUFACTURERS MATERIAL SAFETY DATA SHEETS (MSDS) WHEN USING CHEMICALS AND COSHH REQUIREMENTS.

Filling the Column

Please ensure that the sweep baskets are placed into the test tubes before filling the glass tubes with your gradient liquid and that the cord is safely secured.

Empty the tube and rinse with alcohol and allow too dry. Return the tube back into the water jacket and fit the plastic cap to the top of the tube and secure the tube in place with the tube clamp.

Insert the PTFE tube through the plastic cap and ensure the PTFE filling tube is at the bottom of the test tube.

Carefully place the PTFE stirrer bar into conical **flask A** (the flask with 2 outlet holes) and place the connected flasks onto the filling platform.

Connect the outlet of flask A to the inlet of the pump using the tubing supplied.

Connect the flared end of the PTFE filling tube to the longest length of tubing then connect the other end to the tubing to the outlet of the pump.

Close the nylon screwed pinchcock on the tube connecting the two flasks and the outlet tube of flask A.

Pour the **low density solution A** into **flask A** and the **high density solution B** into **flask B**. Fit the retaining plate over the flasks to keep the flask secure before stirring the liquid.

Open the nylon pinchcock which connects the two flasks. When hydrostatic equilibrium has been reached the stirrer should be switched on for a short period to allow the two solutions to mix in flask A before pumping begins.

Ensure all valves are in the open position and that the PTFE filling tube is situated within the test tube before the pump is switched on. The filling rate depends on the density range of the column. Wider ranges will require longer filling times.

The columns test tube will fill at a constant rate. The mixture of fluids in flask A will become progressively more dense as the liquid enters from **flask B**. It is important to leave the pump on until nearly all of the liquid has been pumped from **flask A**. Once the graduated tube is full, remove the plastic cap and the PTFE tube from the column.

Caution! Turn the pump and stirrer off, immediately as the flasks empty. This will prevent air being pump into the column and destroying the gradient. It is recommended that after use the filling equipment is flushed through with water to prevent hardening of the tubes

The rate of mixing the fluid from **Flask A** to **Flask B** can be controlled by using the pinchcock located between the flasks. The Rate of filling the test tube can be increase by turning the speed control switch located next to the filling pump.

Wide density ranges where there is a considerable difference between the two solutions will require a longer filling time to allow the solution to mix thoroughly in the stirrer flask. The flow into the column is also affected by the density and viscosity of the solution.

If the ambient temperature is above or below 23°C and a supply of water is not available use the equation shown under the heading "**Use and Care of Density Floats**" to apply a correction factor to the density readings.

Once the test tubes have been filled with the correct density gradient wet the floats (in de-ionised water to remove air from the surface) and drop them into the column starting with the lowest density first then replace the rubber cap. Leave the floats to reach equilibrium. Once this has been achieved the gradient column can be calibrated.

Column Clearing Device

The automatic column clearing device (or sweep) clears the density column of test samples and density floats without disturbing the gradient.

The device consists of a swivelled beam that is positioned over the glass test tubes with the basket line attached to the main line using a screw connector. To operate the device, attach a sweep basket to the main cord at the top of the swivel beam and turn on the switch located on

the front panel of the electronics cabinet. Use the up/down switch to activate the sweep in the direction required.

The motor is automatically switched off when the mesh basket reaches the top and bottom of the tube. To change from one basket to another the line will need to be unscrewed and secured to the top of the column tube so other baskets can be raised from the remaining tubes.
Please note that the baskets can only be changed between columns when they are at rest in the bottom of the test tube.

When a column is to be cleared, attach the basket cord of the appropriate column to the clearing device and press the switch into the up (raise) position. The device will rise slowly so the gradient is not disturbed. When the basket reaches the top of the column it will automatically switch off. Once the basket has reached the top, remove the test samples and the density floats then return the basket to the bottom of the tube by pressing the switch into the down position. Repeat the procedure to clear the remaining graduated tubes.

Using the Columns Automatic Measuring System

Column calibration

Caution! Please do not attempt to calibrate the column until the water temperature has stabilised at 23 Deg C

To use the column correctly you must calibrate the column by entering the float value reference into the microprocessor. To do this, ensure that the microscope sight is in the home position.

- Display reads **<Main Menu> <Calibration>**. Press **<Select>**
- Display reads **<Which Column> <Column A>**. Rotate the dial on the front panel to select column B, C or Abort. If Abort is selected the display will default back to the main menu. Once the column to be calibrated has been chosen press **<Select>**.
- Display reads **<Calibration Menu> <Calibrate Column>**. Press **<Select>** to calibrate the column or rotate the dial on the front panel to display **<Check Calibration>** or **<Abort>**
- Display reads **<Calibration Mode> <Float 1> <Add Float>**. Move the microscope sight to the centre of the first float. The focus of the sight can be adjusted by rotating the knob at the side of the microscope. When the centre of the float has been positioned against the microscope cross hair select **<Add Float>**.
  Caution! Please ensure that the microscope has been moved to the appropriate float before selecting the <Add Float> button. If this is not done the reading will not be stored and the calibration will have to be carried out again.
  Enter the density of the float (from the issued calibration certificate) by rotating the dial on the front panel then select **<Enter>**.
- Display reads **<Float 2> <Add Float>**. To add another float, move the microscope sight to the next float and select **<Add Float>**. Rotate the dial on the front panel to the required density and select **<Enter>**.
- Repeat the procedure until all the used floats in the column have been entered into the microprocessor.
- When all of the floats have been entered, rotate the dial on the front panel until the display reads **<End Cal>** then press the green button.

- Display reads **<Save Cal Data>**. Press **<Select>** to save the calibration data to the microprocessor or rotate the dial on the front panel to display **<Continue Cal>** if more floats are to be added or **<Abort Cal>** to abort the calibration procedure.

- When **<Save Cal Data>** is selected the display will read **<Main Menu> <Calibration>**. Repeat the procedure to calibrate the other columns if required.

Sample Density Readings

When the column has been calibrated test samples should be thoroughly wetted before being placed in the column. To aid identification, samples from sheet material should be cut with a sharp blade into various shapes. The time required for the samples to reach equilibrium vary with the type of sample. Granules usually reach maximum density within one hour of immersion whereas thin films may require longer. Several height sightings should be taken until the sample is stable. The density can then be measured.

- Display reads **<Main Menu> <Calibration>**. Rotate the dial until **<Test Samples>** is displayed, then press **<Select>**.

- Display reads **<Column A>**. Rotate the dial on the front display to select the active column you wish to read the sample densities from. When the column has been chosen press **<Select>**.

- Display reads **<Sample 1>**. Move the microscope sight to the centre of the first sample and take the density reading from the display then select **<Next>**.

  (If the thermal printer has been activated the display will read <Print> instead of <Next>)

- Display reads **<Sample 2>**. Move the microscope sight to the centre of the second sample and take the density reading from the display then select **<Next>**.

- Repeat the procedure for all the samples you wish to measure.
- When you have finished taking your readings rotate the dial on the front panel until **<Exit>** is displayed. Press the green button. Display reads **<Main Menu> <Calibration>**.

- Repeat the procedure to read sample densities from another column.

Check a calibrated column

The apparatus has the capability to check a calibrated column for errors which may cause the gradient to break down and become un-reliable. This may be due to a change in atmospheric conditions or simply the amount of time that the column has been in use. To check a calibrated column,

- Display reads **<Main Menu> <Calibration>**. Press **<Select>**

- Display reads **<Which Column> <Column A>**. Rotate the dial on the front display to select the column B, C or Abort. Press **<Select>**

- Display reads **<Calibration Menu> <Calibrate Column>**. Rotate the dial on the front display until the display reads **<Check Calibration>**. Press **<Select>**. If the wrong column has been selected or you wish to exit the procedure rotate the dial until **<Abort>** is displayed.

- Display reads **<Calibration Check> <Float No>** and **<Density>**. Move the microscope viewer to float 1. When the microscope is in range of the floats density the apparatus

will “Beep”. The display will read **<Float 1>** followed by the float density. Check the position of the float to see if its position is still relative to the density reading on the display. If the float has moved then re-calibration of the gradient will be required.

- To return to the main menu select **<Exit>**

Errors due to Air

A major source of errors, in columns containing water, is air absorbed in the solution, forming bubbles on the floats and samples, which can be very small and difficult to detect. A cyclic movement of the floats or samples usually indicates the presence of small bubbles. These air bubbles can be prevented by de-gassing the two solutions before filling the column.

- **Ethanol solutions** should be de-gassed by using a vacuum.
- **Salt solutions** should be de-gassed by boiling.

If air bubbles form on the floats, remove the float from the column. This can be done using a long thin piece of wire, with a ring at the end, bent at right angles. Once the float has been removed dip it in distilled water containing a few drops of liquid soap, then return the float to the column. **Caution! This must be done carefully so the gradient is not disturbed.** If the bubbles persist after re-wetting the samples or floats the column should be built again taking the recommended precautions.

Use and Care of density Floats

Calibrated Density Floats are manufactured from coloured soda/lime glass. No appreciable change in density has been recorded after several years use in water/ethanol or hydrocarbon solutions. If the floats are to be used in strong alkaline solutions it is advisable to periodically check one float by comparison with a float not used in a alkaline solution. Alternatively Ray-Ran can offer a re-calibration service.

Although the floats come with a complete calibration certificate it is advisable to record the colour, markings, diameter and density of each float in a register or log book to ease the identification process.
Do not use metallic measuring devices such as micrometers or vernier callipers to measure the floats unless of the plastic type.

Before the floats are put into the gradient column they should be wetted in the residue from the filling device or similar solution to prevent air bubbles. Finger marks can make wetting the floats difficult. If this is the case the floats should be cleaned with a suitable detergent solution.

After long periods of use the floats may become covered in a thin film of material from the samples. This film can be removed by immersing the float in a diluted solution of nitric acid. The floats should not be cleaned with paper towels or laboratory wipes as repeated rubbing can alter the floats density.

Correction Factor

If the floats are used at temperatures other than 23° C a correction should be applied to obtain maximum accuracy. The correction is obtained with the following equation,

Correction for 1°C difference in temperature = Float density at 23°C x 0.000028

This equation is then applied as follows,

Below 23°C = **Stated density of Float + Correction for each °C difference in temperature**

Above 23°C = **Stated density of Float - Correction for each °C difference in temperature**

Care of the Density Column

Some solutions can damage the Perspex water jacket and acrylic finishes. It is therefore important that all spills are mopped up immediately. The water jacket **should not** be cleaned with acetone or similar solvents, which will cause stresses and cracking. A mild detergent solution should be used for general cleaning. More persistent stains and small scratches can be removed with an **Aerosol Acrylic Polish**.

After opening the pinchcock on the filling platform, check the interconnecting tube for air bubbles, these can be removed by momentarily lifting one flask. After use, disconnect the filling tube, remove the flasks from the platform, rinse them with water and allow to dry. They should be stored in a safe place with the connecting tubes attached.

Solutions and Densities

Solution	Density Range KG/M³
Methanol – Benzyl – Alcohol	800 – 920
Isopropanol – water	790 – 1000
Isopropanol – Diethylene Glycol	790 – 1000
Ethanol – Carbon Tetrachloride	790 – 1590
Ethanol – Water	790 – 1000
Toluene – Carbon Tetrachloride	870 – 1590
Water – Calcium Nitrate	1000 – 1450
Water – Potassium Iodide	1000 – 1600
Water – Sodium Bromide	1000 – 1600
Zinc Chloride – Ethanol – Water	800 – 1700
Carbon Tetrachloride – 1,3 –Dibrompropane	1600 – 1990
1,3 –Dibrompropane – Ethanol Bromide	1990 – 2190
Ethylene Bromoform	2180 – 2890
Carbon Tetrachloride - Bromoform	1600 - 2890
The following may also be used in various mixtures	
n-octane	700
Dimethylformahide	940
Tetrachlorethane	1590
Ethyl Iodide	1930
Methylene Iodide	3330

WARNING

Many of these liquids are TOXIC and/or inflammable. Attention should be paid to all appropriate safety precautions and Safety Data Sheets, which should be obtained from the chemical suppliers. COSHH regulations should be observed at all times.

Densities of Aqueous Organic Solutions

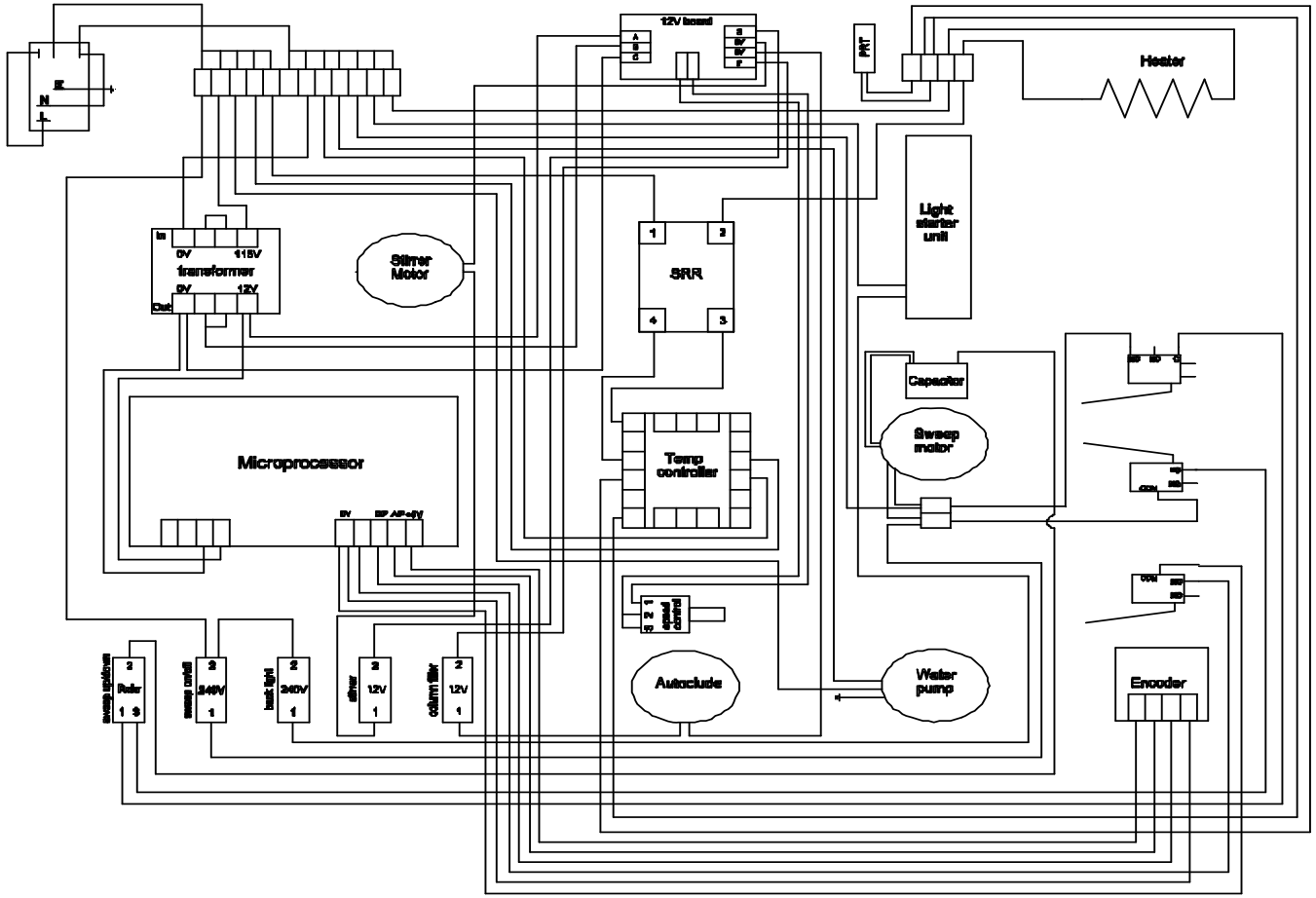
Ethyl Alcohol (C2H3 OH)

%	10°c	15°c	20°c	25°c	30°c	35°c	40°c	%	10°c	15°c	20°c	25°c	30°c	35°c	40°c
0	.99973	.99913	.99823	.99708	.99568	.99406	.99225	50	.92126	.91776	.91384	.90985	.90580	.90168	.89750
1	765	725	636	520	379	217	034	51	.91943	555	160	760	353	.89940	519
2	602	542	453	336	194	031	.98846	52	723	333	.90936	534	125	710	288
3	426	365	275	157	014	.98849	663	53	502	110	711	307	.89896	479	056
4	258	195	103	.98984	.98839	672	485	54	279	.90885	485	079	667	248	.88823
5	098	032	.98938	817	670	501	311	55	055	659	258	.89850	437	016	589
6	.98946	.98877	780	656	507	335	142	56	.90831	433	031	621	206	.88784	356
7	801	729	62	509	347	172	.97978	57	607	207	.89803	392	.88975	552	122
8	660	584	478	346	189	009	808	58	381	.89980	574	162	744	319	.87888
9	524	442	331	193	031	.97846	641	59	154	752	344	.88931	512	085	653
10	393	304	187	043	.97875	685	475	60	.89927	523	113	699	278	.87851	417
11	267	171	047	.97897	723	527	312	61	698	293	.88882	446	044	615	180
12	145	041	.97910	753	573	371	150	62	468	062	650	233	.87809	379	.86943
13	026	.97914	775	611	424	216	.96989	63	237	.88830	417	.87998	574	142	705
14	.97911	790	643	472	278	063	829	64	006	597	183	763	337	.86905	466
15	800	669	514	334	133	.96911	670	65	.88774	364	.87948	527	100	667	227
16	692	552	387	199	.96990	760	512	66	541	130	713	291	.86863	429	.85987
17	583	433	259	062	844	607	352	67	308	.87895	477	054	625	190	747
18	473	313	129	.96923	697	452	189	68	074	660	241	.86817	387	.85950	407
19	363	191	.96997	782	547	294	023	69	.87839	424	004	579	148	710	266
20	252	068	864	639	395	134	.95856	70	602	187	.86766	340	.85908	470	025
21	139	.96944	729	495	242	.95973	687	71	365	.86949	527	100	667	228	.84783
22	024	818	592	348	087	809	516	72	127	710	287	.85859	426	.84986	540
23	.96907	689	453	199	.95929	643	343	73	.86888	470	047	618	184	743	297
24	787	558	312	048	769	476	168	74	648	229	.85806	376	.84941	500	053
25	665	424	168	.95895	607	306	.94991	75	408	.85988	564	134	698	257	.83809
26	539	287	020	738	442	133	810	76	168	747	322	.84891	455	013	564
27	406	144	.95867	576	272	.94955	625	77	.85927	505	079	647	211	.83768	319
28	268	.95996	710	410	098	774	438	78	685	262	.84835	403	.83966	523	074
29	125	844	548	241	.94922	590	248	79	442	018	590	158	720	277	.82827
30	.95977	686	382	067	741	403	055	80	197	.84772	344	.83911	473	029	578
31	823	524	212	.94890	557	214	.93860	81	.84950	525	096	664	224	.82780	329
32	665	357	038	709	370	021	662	82	702	277	.83848	415	.82974	530	079
33	502	186	.94860	525	180	.93825	461	83	453	028	599	164	724	279	.81828
34	334	011	679	337	.93986	626	257	84	203	.83777	348	.82913	473	027	576
35	162	.94832	494	146	790	425	051	85	.83951	525	095	660	220	.81774	322
36	.94986	650	306	.93952	591	221	.92843	86	697	271	.82840	405	.81965	519	067
37	805	464	114	756	390	016	634	87	441	014	583	148	708	262	.80811
38	620	273	.93919	556	186	.92808	422	88	181	.82754	323	.81888	448	003	552
39	431	079	720	353	.92979	597	208	89	.82919	492	062	620	186	.80742	291
40	238	.93882	518	148	770	385	.91992	90	654	227	.81797	362	.80922	478	028
41	042	682	314	.92940	558	170	774	91	386	.81959	529	094	655	211	.79761
42	.93842	476	107	729	344	.91952	554	92	114	688	257	.80823	384	.79941	491
43	639	271	.92897	516	128	733	332	93	.81839	413	.80983	549	111	669	220
44	433	062	685	301	.91910	513	108	94	561	134	705	272	.79835	393	.78947
45	226	.92852	472	035	692	291	.90884	95	278	.80852	424	.9991	555	114	670
46	017	640	257	.91888	472	069	660	96	.80991	566	138	706	271	.78831	388
47	.92806	426	041	649	250	.90845	434	97	698	274	.79846	415	.78981	542	100

48	593	211	.91823	429	028	621	207	**98**	399	.79975	547	117	684	247	.77806
49	379	.91995	604	208	.90805	396	.89979	**99**	094	670	243	.78814	382	.77946	507
								100	.79784	368	.78934	506	075	641	203

Drawing Approved	
signed by	

THIRD ANGLE PROJECTION



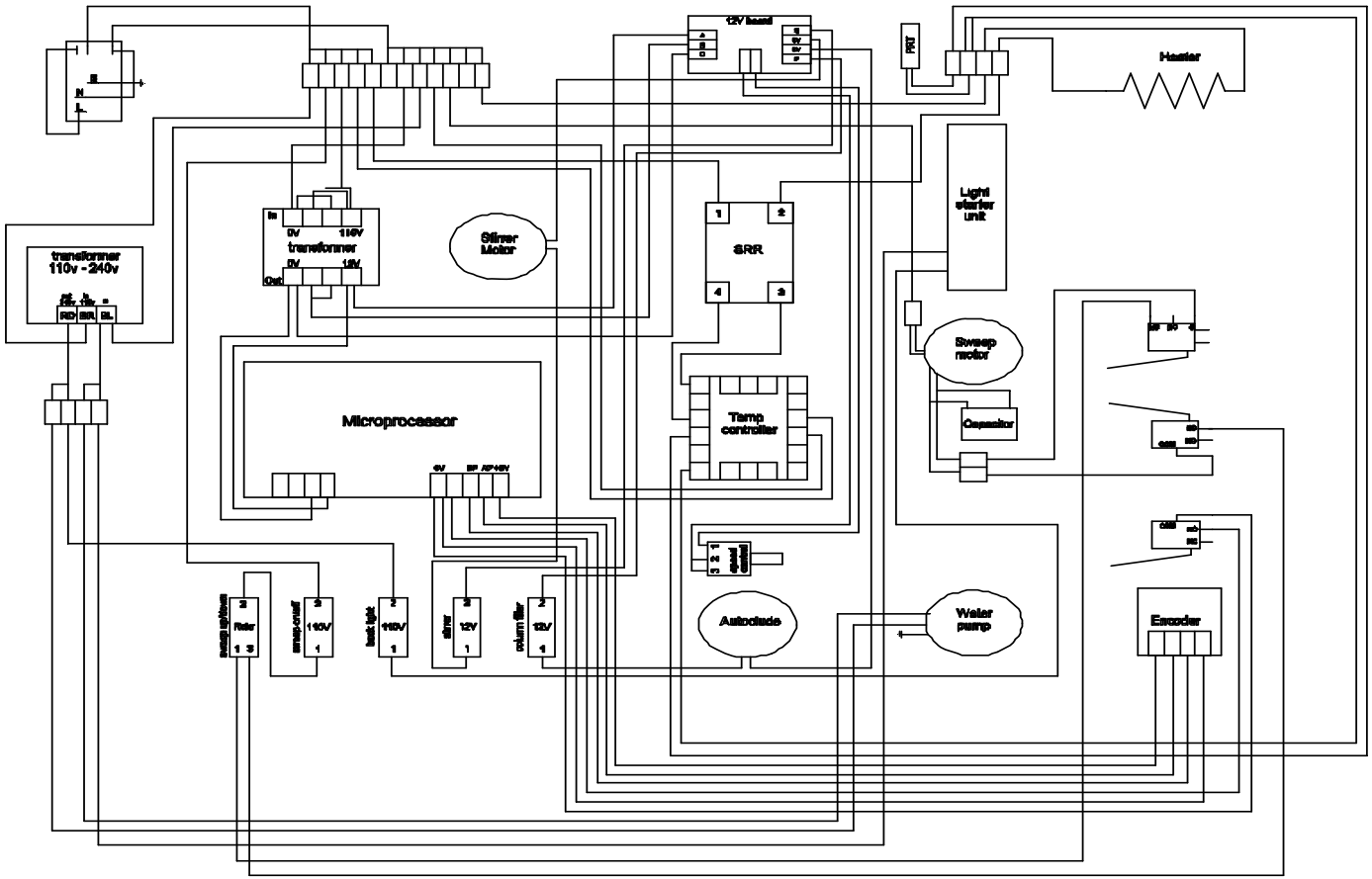
FOR TOLERANCES AND SYMBOLS SEE DRAWING OFFICE CODE OF PRACTICE

MATERIAL REQ`D	
PROCESSES	
Spray	
Heat Treat	
Chem Black	
Annodise	
Electro Plate	
COMMENTS	
Live ciruit Neutral circuit 12V circuit Electronic & PRT circiut	

RAY-RAN TEST EQUIPMENT LTD	DESCIPTION: Density Column wiring Diagram	DIM`S MM (unless stated)	DO NOT SCALE
		DRAWN BY A.L	ISSUE No 2
	QTY 1	DATE 10/05/2006	DWG No DGA WD 240V

Drawing Approved	
signed by	

THIRD ANGLE PROJECTION



MATERIAL REQ`D

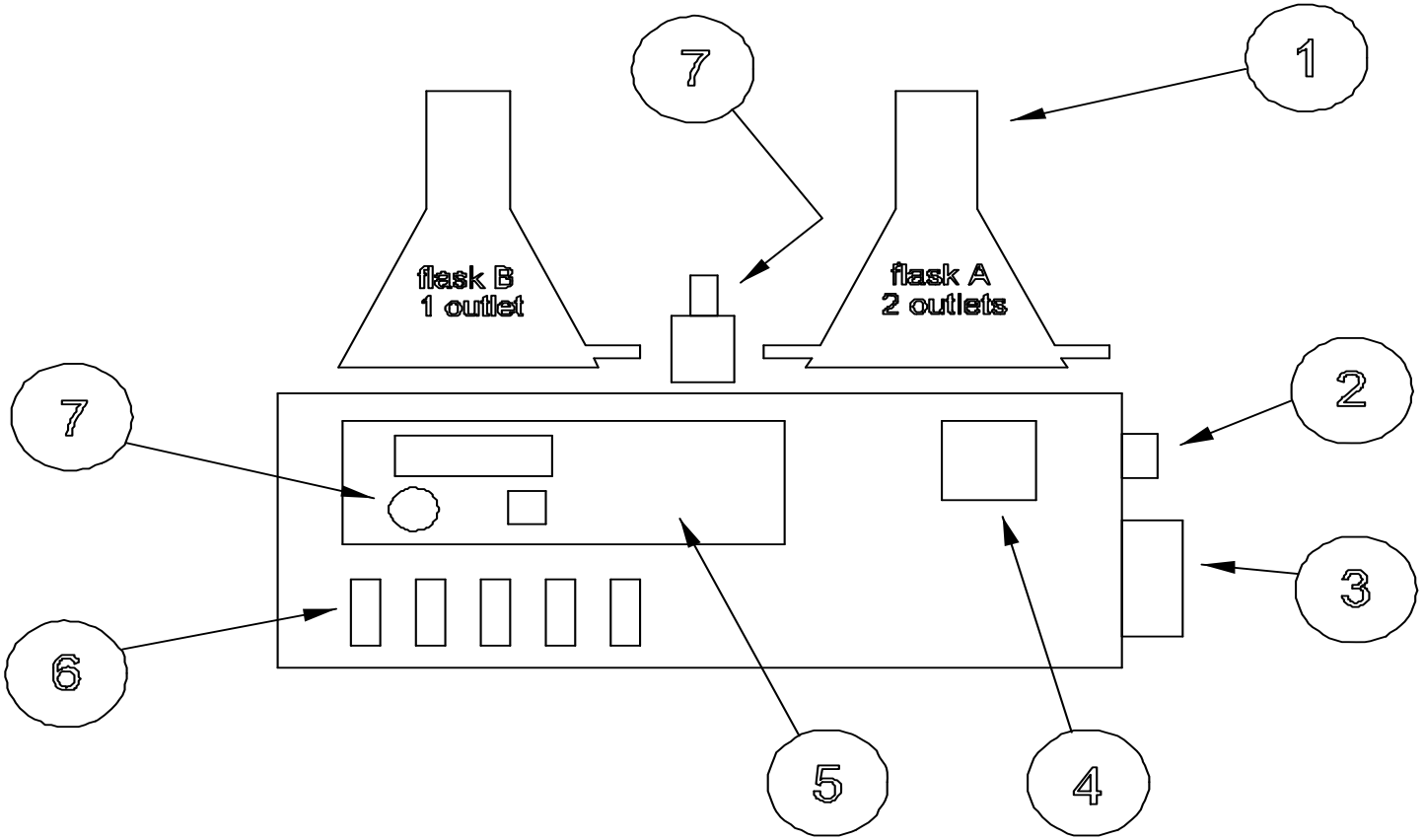
PROCESSES	
Spray	
Heat Treat	
Chem Black	
Annodise	
Electro Plate	

COMMENTS
Live ciruit Neutral circuit 12V circuit 0v circuit Electronic & PRT circiut

FOR TOLERANCES AND SYMBOLS SEE DRAWING OFFICE CODE OF PRACTICE

RAY-RAN TEST EQUIPMENT LTD	DESCIPTION: Density Column wiring Diagram	DIM`S MM (unless stated)	DO NOT SCALE
		DRAWN BY A.L	ISSUE No 2
	QTY 1	DATE 10/05/2006	DWG No DGA WD 110v

THIRD ANGLE PROJECTION



flasks	1
Pump Speed	2
Pump	3
Temp Cont	4
Display	5
Switches	6
Display Select	7

MATERIAL REQ`D

PROCESSES	
Spray	
Heat Treat	
Chem Black	
Anodise	
Electro Plate	

COMMENTS

FOR TOLERANCES AND SYMBOLS SEE DRAWING OFFICE CODE OF PRACTICE

RAY-RAN TEST EQUIPMENT LTD	DESCIPTION: Pumped Filling System	DIM`S MM (unless stated)	DO NOT SCALE
		DRAWN BY A.L	ISSUE No 1
	QTY	DATE 12/01/2006	DWG No RR/DGA/PFS

Ray Ran Products and Services

Raw Material Evaluation

Code	Product
RR/5MBA	Model 5MBA Melt Flow Indexer
RR/5SA	Model 5SA Melt Flow Indexer
RR/5MPCA	Model 5MPCA Melt Flow Indexer
RR/DGA	3 Column Density Gradient Apparatus
RR/BDA	Apparent Bulk Density Apparatus
RR/ADV	Adventurer Balance (Readability 0.1mg) 110/260g Capacity
RR/VOY	Voyager Balance (Readability 0.1mg) 62/410/100g Capacity
RR/DIS	Discovery Balance (Readability 0.1mg) 110/310g Capacity
RR/MB	Moisture Balance (Readability 0.1%, 0.05%, 0.01%) 110/35/45g Cap

Sample Preparation

Code	Product
RR/TSMP2	Model 2 Test Sample Injection Moulding Apparatus
RR/HCP	Hand Operated Test Sample Cutting Press
RR/PCP	Pneumatically Operated Test Sample Cutting Press
RR/NC	Auto Cycle Test sample Notching Cutter
RR/CNC	Test Sample Profile Cutter
RR/CNC 2	Test Sample Profile Cutter - Larger
TSC + Standard	Test Sample Cutters

Sample Testing

Code	Product
RR/HDV2	2 Station HDT/Vicat Softening Point Apparatus
RR/HDV4	4 Station HDT/Vicat Softening Point Apparatus
RR/HDV6	6 Station HDT/Vicat Softening Point Apparatus
RR/TAA	Thermal Ageing Apparatus
RR/LTB	Low Temperature Brittleness Tester
RR/ESC	Environmental Stress Cracking Apparatus
RR/FSL	Unrestrained Linear Thermal Film Shrinkage Apparatus
RR/FSHP	Hot Plate Film Shrinkage Apparatus
RR/IMT	Universal Pendulum Impact Tester
RR/FWT	Falling Weight Impact Tester
RR/FD	Falling Dart Impact Tester
RR/ETT	Advanced Elmendorf Tear Tester
RR/FT	Static And Dynamic Friction Tester
RR/M	Universal Tensile Tester – Various Capacity
D202	Digital Handheld Durometer
B202	Analogue Handheld Durometer
WS777	Analogue & Digital Durometer Workstations